

## AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

### Listing of Claims:

1           1-7 (Canceled).

1           8. (Original) A computer-readable storage medium storing instructions  
2           that when executed by a computer cause the computer to perform a method for  
3           using a computer system to solve a system of nonlinear equations specified by a  
4           vector function,  $\mathbf{f}$ , wherein  $\mathbf{f}(\mathbf{x}) = \mathbf{0}$  represents a set of nonlinear equations,  $f_1(\mathbf{x})$   
5            $= 0, f_2(\mathbf{x}) = 0, f_3(\mathbf{x}) = 0, \dots, f_n(\mathbf{x}) = 0$ , wherein  $\mathbf{x}$  is a vector  $(x_1, x_2, x_3, \dots, x_n)$ , the  
6           method comprising:  
7           receiving a representation of a subbox  $\mathbf{X} = (X_1, X_2, \dots, X_n)$ , wherein for  
8           each dimension,  $i$ , the representation of  $X_i$  includes a first floating-point number,  
9            $a_i$ , representing the left endpoint of  $X_i$ , and a second floating-point number,  $b_i$ ,  
10          representing the right endpoint of  $X_i$ ;  
11          storing the representation in a computer memory;  
12          applying term consistency to the set of nonlinear equations,  $f_1(\mathbf{x}) = 0$ ,  
13           $f_2(\mathbf{x}) = 0, f_3(\mathbf{x}) = 0, \dots, f_n(\mathbf{x}) = 0$ , over  $\mathbf{X}$ , and excluding portions of  $\mathbf{X}$  that violate  
14          any of these nonlinear equations;  
15          applying box consistency to the set of nonlinear equations over  $\mathbf{X}$ , and  
16          excluding portions of  $\mathbf{X}$  that violate any of the nonlinear equations; and  
17          performing an interval Newton step on  $\mathbf{X}$  to produce a resulting subbox  $\mathbf{Y}$ ,  
18          wherein the point of expansion of the interval Newton step is a point  $\mathbf{x}$  within  $\mathbf{X}$ ,

19 and wherein performing the interval Newton step involves evaluating  $\mathbf{f}(\mathbf{x})$  using  
20 interval arithmetic to produce an interval result  $\mathbf{f}^I(\mathbf{x})$ .

1 9. (Original) The computer-readable storage medium of claim 8, wherein  
2 performing the interval Newton step involves:  
3 computing  $\mathbf{J}(\mathbf{x}, \mathbf{X})$ , wherein  $\mathbf{J}(\mathbf{x}, \mathbf{X})$  is the Jacobian of the function  $\mathbf{f}$   
4 evaluated as a function of  $\mathbf{x}$  over the subbox  $\mathbf{X}$ ; and  
5 determining if  $\mathbf{J}(\mathbf{x}, \mathbf{X})$  is regular as a byproduct of solving for the subbox  $\mathbf{Y}$   
6 that contains values of  $\mathbf{y}$  that satisfy  $\mathbf{M}(\mathbf{x}, \mathbf{X})(\mathbf{y} - \mathbf{x}) = \mathbf{r}(\mathbf{x})$ , where  
7  $\mathbf{M}(\mathbf{x}, \mathbf{X}) = \mathbf{B}\mathbf{J}(\mathbf{x}, \mathbf{X})$ ,  $\mathbf{r}(\mathbf{x}) = -\mathbf{B}\mathbf{f}(\mathbf{x})$ , and  $\mathbf{B}$  is an approximate inverse of the center of  
8  $\mathbf{J}(\mathbf{x}, \mathbf{X})$ .

1 10. (Original) The computer-readable storage medium of claim 9, wherein  
2 the method further comprises:  
3 applying term consistency to the preconditioned set of nonlinear equations  
4  $\mathbf{B}\mathbf{f}(\mathbf{x}) = \mathbf{0}$  over the subbox  $\mathbf{X}$ ; and  
5 excluding portions of  $\mathbf{X}$  that violate the preconditioned set of nonlinear  
6 equations.

1 11. (Original) The computer-readable storage medium of claim 9, wherein  
2 the method further comprises:  
3 applying box consistency to the preconditioned set of nonlinear equations  
4  $\mathbf{B}\mathbf{f}(\mathbf{x}) = \mathbf{0}$  over the subbox  $\mathbf{X}$ ; and  
5 excluding portions of  $\mathbf{X}$  that violate the preconditioned set of nonlinear  
6 equations.

1 12. (Original) The computer-readable storage medium of claim 8, wherein  
2 applying term consistency to the set of nonlinear equations involves:

3 for each nonlinear equation  $f_i(\mathbf{x}) = 0$  in the system of equations  $\mathbf{f}(\mathbf{x}) = \mathbf{0}$ ,  
 4 symbolically manipulating  $f_i(\mathbf{x}) = 0$  to solve for an invertible term,  $g(x'_j)$ , thereby  
 5 producing a modified equation  $g(x'_j) = h(\mathbf{x})$ , wherein  $g(x'_j)$  can be analytically  
 6 inverted to produce an inverse function  $g^{-1}(\mathbf{y})$ ;  
 7 substituting the subbox  $\mathbf{X}$  into the modified equation to produce the  
 8 equation  $g(X'_j) = h(\mathbf{X})$ ;  
 9 solving for  $X'_j = g^{-1}(h(\mathbf{X}))$ ; and  
 10 intersecting  $X'_j$  with the vector element  $X_j$  to produce a new subbox  $\mathbf{X}^+$ ;  
 11 wherein the new subbox  $\mathbf{X}^+$  contains all solutions of the system of  
 12 equations  $\mathbf{f}(\mathbf{x}) = \mathbf{0}$  within the subbox  $\mathbf{X}$ , and wherein the width of the new subbox  
 13  $\mathbf{X}^+$  is less than or equal to the width of the subbox  $\mathbf{X}$ .

1 13. (Original) The computer-readable storage medium of claim 8, wherein  
 2 the method further comprises:  
 3 evaluating a first termination condition, wherein the first termination  
 4 condition is TRUE if,  
 5 zero is contained within  $\mathbf{f}^l(\mathbf{x})$ ,  
 6  $\mathbf{J}(\mathbf{x}, \mathbf{X})$  is regular, wherein  $\mathbf{J}(\mathbf{x}, \mathbf{X})$  is the Jacobian of the  
 7 function  $\mathbf{f}$  evaluated as a function of  $\mathbf{x}$  over the subbox  $\mathbf{X}$ , and  
 8 the solution  $\mathbf{Y}$  of  $\mathbf{M}(\mathbf{x}, \mathbf{X}) (\mathbf{y} - \mathbf{x}) = \mathbf{r}$  contains  $\mathbf{X}$ ; and  
 9 if the first termination condition is TRUE, terminating and recording  $\mathbf{X}$  as  
 10 a final bound.

1 14. (Original) The computer-readable storage medium of claim 13,  
 2 wherein the method further comprises:  
 3 evaluating a second termination condition;

4           wherein the second termination condition is TRUE if a function of the  
5   width of the subbox **X** is less than a pre-specified value,  $\varepsilon_X$ , and the width of the  
6   function **f** over the subbox **X** is less than a pre-specified value,  $\varepsilon_F$ ; and  
7           if the second termination condition is TRUE, terminating and recording **X**  
8   as a final bound.

1           15-21 (Canceled).